XXI. *Experiments and Obſervations to inveſtigate the Compoſition of* James's *Powder. By* George Pearſon, *M. D. F. R. S.; communicated by Sir* Joſeph Banks, *Bart. P. R. S.*

Read June 23, 1791.

THE medicine upon which many phyſicians principally depend in the cure of continued fevers is JAMES's *Powder*; but, although it has been very extenſively uſed above thirty years, the public have not, I believe, been informed of the particular nature of this ſubſtance. This *powder* was originally a patent medicine; but it is well known that it cannot be prepared by following the directions of the ſpecification in the Court of Chancery. Preſuming that I have made ſome experiments and obſervations which may explain the nature and manner of preparing this medicine, and, perhaps, may extend the hiſtory of antimony; I beg leave to have the honour of preſenting an account of them to the Royal Society.

Senſible properties of JAMES's *Powder.*

Some parcels of this preparation are white, but in general it has a yellowiſh caſt; and this ſhade is more evident in ſome ſpecimens than in others. It is ſaid, that this powder cannot, in general, be made at different times of preciſely the ſame ſhade of yellow or degree of whiteneſs. Sometimes with the aid of a lens a few very ſmall ſhining *ſpicula* are ſeen mixed with powder. When preſſed between the fingers it feels ſmooth,

ſmooth, with ſome rather rough particles, and it is gritty in the mouth. Moſt parcels at firſt are taſteleſs; but in about a minute there is a ſlight braſſy taſte. It is perfectly inodorous.

Specific gravity.

This powder feels much heavier than any of the common earths and ſtones in a pulverized ſtate. One of the phials, nearly full, in which it is ſold, reckoned to hold a quantity equal to twelve packets, or 480 grains, contained 470 grains troy weight of JAMES's powder. This phial, filled with diſtilled water to the ſame height that it had been by the powder, was found to contain nearly four drachm-meaſures, or about 240 grains, of this liquid *.

Effects of fire.

(*a*) The exterior part of the flame of a candle applied, by means of the blow-pipe, to about one, two, and three grains of JAMES's Powder on charcoal, and alſo in the ſpoon, only made it yellowiſh while hot, but, on cooling, this colour diſappeared. The interior and hotteſt part of the blue flame turned this powder yellow, and when continued ſo as to ignite it, a white inodorous fume or vapour aroſe, which ſoon ceaſed; and though the heat was continued, the powder neither appeared to diminiſh nor melt; but, on cooling, a ſlightly co-

* After this Paper had been read, an experiment, in a different manner, was made to aſcertain the ſpecific gravity of this powder. The quantity which nearly filled a phial weighed 437 grains; and filling the ſame phial, to the ſame height, with diſtilled water, the temperature of which was 65°, the water weighed 250,2 grains. The reaſon of the variation in theſe reſults, in making uſe of different parcels of this medicine, will be obvious, from the following account of its preparation, and the great difficulty of determining, with accuracy, the ſpecific gravity of powders.

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hering white folid, about three-fourths of the original weight of the powder, was left. If the flame was fuddenly withdrawn, as foon as the white fumes appeared, they afcended with a kind of revolving motion.

(*b*) Two grains of this powder, mixed with about three of pulverized tartar, being expofed on charcoal to flame applied by the blow-pipe, the mixture turned black, boiled, and fwelled; and by continuing to apply the flame, the coaly matter of the tartar difappeared, a part of the mixture fufed, and in that ftate feveral fmall, filvery, apparently metallic grains were perceived. On cooling, they were feen with the naked eye, or with a lens, adhering to an irregularly figured, partially melted, whitifh mafs. On a fecond application of the flame, thefe metallic globules difappeared.

(*c*) JAMES's Powder, with glafs of phofphoric acid, melted into an opaque yellowifh globule while hot, which on cooling grew whitifh.

(*d*) This Powder, with feveral times its weight of melted borax, afforded a colourlefs tranfparent glafs while fluid; but, on adding a larger proportion of powder, the globule turned opaque, and when cold became of a milky whitenefs. As the JAMES's Powder mixed, or melted, with the fufed falt, flight explofions were feveral times heard.

(*e*) With foffil alkali, in the fpoon, this powder apparently fufed, and afforded a colourlefs tranfparent fluid in a ftate of rotatory motion; but on cooling it grew opaque, and had a horny appearance.

(*f*) 100 grains of this powder in a two-inch Englifh crucible, the cover of which was luted on it as clofely as poffible, were expofed above two hours to a fierce fire in a melting furnace. On breaking this crucible, when cold, the powder was

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found changed into an entire very hard white ſolid, receiving its figure from the veſſel, and weighed 95 grains. On breaking this hard ſolid, the lower part of it ſeemed to be vitrified, or in a ſtate of enamel; and being powdered, it afforded a much whiter powder, and of greater ſpecific gravity, than before. The degree of fire denoted by WEDGWOOD's pyrometer was 166°.

Theſe experiments indicated the preſence of a metallic calx, a part at leaſt of which was that of antimony, mixed with earthy matter.

Experiments with different menſtrua applied to JAMES's *Powder.*

I. *With water.*

300 grains of this powder were digeſted for ſeveral hours in twenty-ſeven ounces of diſtilled water, and then boiled for one hour. While boiling the water appeared milky; but in half a minute's time, after withdrawing the lamp over which it boiled, the liquid became nearly clear, and the ſediment depoſited was apparently the powder undiminiſhed in quantity, and in other reſpects unaltered. While hot the liquid was decanted upon a filter of ſeveral folds of paper previouſly weighed, through which twenty ounces of quite clear liquid, like water, readily paſſed. Very little powder could be perceived on the filter; but when it was well dried, it weighed fourteen grains more than before the experiment. The filtered liquor was taſteleſs. In about three quarters of an hour it grew ſlightly *turbid*, and in ten minutes after became *milky*. On ſtanding eight days longer, the milkineſs diminiſhed, and a ſmall quantity, perhaps four grains, of cloſe white ſediment, firmly adhering to the ſides of the veſſel, were depoſited. A little of this ſlightly milky fluid being made hot, it grew quite clear, and on cooling

 turned

turned milky as before, or deposited a sediment; therefore, this milkiness depended on cold water dissolving a smaller proportion of JAMES's Powder than hot water. The whole of the filtered milky liquor was poured upon a filter as before, through which it passed without any diminution of its turbid appearance; and, on drying, the filter was found to have increased only a quarter of a grain in weight. Some of the vapour that arose during the ebullition being condensed was found to be pure water.

On a repetition of this experiment the phænomena above related were always observed; but the semi-vitrified JAMES's Powder above-mentioned (*f*) afforded a much less milky fluid and sediment than the powder used in the preceding experiment.

In order to determine the kind of substances in water after boiling in it JAMES's Powder, the following re-agents were added to the above filtered liquor.

1. Acid of sugar sometimes occasioned immediately more turbidness, and at other times transparency was instantly produced; but in all cases, on standing, more sediment fell than from the filtered liquor alone.

2. Muriated barytes in about an hour rendered this liquid evidently more turbid, and on standing more sediment was deposited than from the filtered liquid to which nothing had been added.

3. Lime-water occasioned immediately a curdy appearance.

4. Infusion of turnsole was sometimes turned to a slight red; but in general it was not altered in colour.

5. Nitre of silver produced in a few hours a slight sediment.

6. Prussianated alkali of tartar occasioned no alteration immediately, nor for four days after adding acetous acid to this mixture.

7. Mild alkali of tartar, and likewiſe mild foſſil alkali, though boiled in this liquor, did not occaſion any additional precipitation.

The ſediment that fell, on merely ſtanding, from the above filtered liquid, was next examined.

1. It did not diſſolve in 100 times its weight of boiling hot concentrated acetous acid; nor,

2. Was it apparently acted upon by boiling with mild alkali of tartar; for, after decanting the clear liquid of this mixture, the ſediment from it was not diſſolved by a large quantity of acetous acid, but readily by marine acid.

3. This ſediment immediately diſappeared on pouring upon it a much ſmaller quantity of marine acid, and alſo of acid of nitre, than had been applied of acetous acid, without any ſolution enſuing.

4. To one portion of this ſolution in marine acid juſt mentioned, was added gradually lixivium of alkali of tartar; after the effervescence had ceaſed to be produced, the firſt drop occaſioned a turbid appearance, and the liquid did not grow clear again on adding a large proportion of vinegar to make it ſour.

5. Another portion of this ſolution in marine acid, being boiled to carry off the ſuperabundant acid, was poured into a large proportion of lime-water, by which it was rendered cloudy, and did not become clear again on adding concentrated acetous acid to make it ſour.

6. To a third portion of this ſolution in marine acid, from which the redundant acid had been carried off, twenty drops of Pruſſian alkaline lixivium were added, which immediately turned it of a bluiſh caſt without diſturbing its tranſparency; and, after ſtanding four days, a ſmaller quantity of pale blue ſediment

ſediment was depoſited than had fallen from a quantity of diſtilled water equal to this muriatic ſolution, to which had been added twenty drops of this Pruſſian alkaline lixivium, and one-fourth part of a drop of muriated antimony. The ſame Pruſſian alkali mixed with vinegar, on ſtanding, turned bluiſh, but depoſited nothing.

7. Though the ſediment that fell in the filtered fluid, p. 320. on merely ſtanding, diſſolved in the nitrous acid as above mentioned; yet, when this acid was added in a ſmaller proportion, but to render the mixture ſour, a partial ſolution only took place. On adding, however, a very ſmall quantity of marine acid, the ſolution was total, and with leſs ſuperabundance of this menſtruum than of the nitrous acid in which a part remained undiſſolved. This ſolution

(*a*) With water depoſited Algaroth powder:

(*b*) With Pruſſian alkali turned bluiſh, and, on ſtanding, a ſmall quantity of ſediment took place.

(*c*) A bright plate of copper, immerſed in this ſolution, did not appear to be at all whitened, or rendered paler.

(*d*) Muriated barytes rendered this ſolution very turbid inſtantly.

(*e*) Acid of ſugar produced no change, except in two or three days a very minute portion of ſediment; but the ſaccharated ſoda immediately occaſioned a ſlight precipitation.

(*f*) Alkali of tartar, fully aërated, rendered this ſolution ſlightly turbid; but cauſtic mineral alkali induced no change.

(*g*) Lime-water, in a ſmall proportion, did not affect the tranſparency; but in a larger produced copious clouds.

The James's Powder which afforded the ſolution in water, on which the experiments above related were made, was boiled a ſecond time in eighteen ounces of diſtilled water for

 two

two hours. The decanted and filtered liquid on cooling grew leſs turbid than before, p. 320. and depoſited leſs ſediment. The filter, on drying, was found to have gained ten grains, though very little powder could be ſeen upon it. The experiments above related, were made on this filtered liquor, and in a ſlighter degree the ſame appearances were obſerved.

The JAMES's Powder remaining after theſe experiments, being well dried, weighed 260 grains, and therefore was found to have loſt 40 grains, partly by ſolution in water, but ſtill more by its adhering to the filters.

I wiſhed to know the proportion in which JAMES's Powder diſſolved in water; and therefore evaporated, in a very thin light glaſs pan, previouſly weighed, twenty-four ounces of the filtered liquids, p. 320. and p. 324. Very little precipitated matter appeared till nearly the whole of the liquor was evaporated; and, when the whole was carried off, a taſteleſs, whitiſh, leafy, or mica-like ſediment, but in ſome parts black, was left, that weighed ſix grains. This ſediment required above 100 times its weight of hot water to diſſolve it. It was boiled in 500 times its weight of diſtilled water, and it paſſed through ſeveral folds of filtering paper rather turbid even while hot; nor could it be rendered clear by repeated filtration through paper. This filtered liquid,

(*a*) With infuſion of turnſole and turmeric, betrayed no alkaline ſubſtance, nor deciſively any acidity.

(*b*) Lime-water rendered it curdy; and on adding vinegar, it grew milky.

(*c*) With acid of ſugar it grew clear; but, on ſtanding, was more turbid than before.

(*d*) Salited

(*d*) Salited barytes made it inftantly turbid.

(*e*) Alkalies, mild and cauftic, induced no change.

(*f*) Pruffian alkali produced only a clear greenifh colour, after the addition of vinegar, and long ftanding.

(*g*) A very fmall quantity of marine acid rendered it quite clear; but it required much more nitrous acid to produce this effect; and this mixture did not whiten copper.

(*h*) With nitre of filver the filtered liquor turned of a fomewhat bluifh hue, and afterwards curdy.

The undiffolved matter that remained on the filter, p. 324. l. 22. above mentioned, appeared, on examination, to be the fame kind of fubftance, with a larger proportion of iron, as that which was diffolved by water, the experiments on which have been juft mentioned. In particular, it afforded Algaroth powder, but did not whiten, in the fmalleft degree, a copper plate.

The following conclufions may, perhaps, be juftifiably drawn from thefe experiments on JAMES's Powder with water.

1. That the whole, or a part, is foluble, or at leaft may be fufpended, in about 2000 times its weight of pure water cold; and in about half this quantity of boiling water.

2. That this folution contains calcareous earth united to an acid, or fome other fubftance, from which it cannot be difunited by cauftic or mild fixed alkalies; therefore, the precipitation by muriated barytes cannot be referred to vitriolated lime.

3. That this folution contains a metallic calx, a part of which at leaft is that of antimony uncombined, or at leaft not united to any acid with which it forms a compound foluble in water.

4. That

4. That the ſubſtance in the nitrous ſolution of the part of JAMES's Powder that had been diſſolved in water, which precipitates lime from lime-water, and which precipitate is not ſoluble in a large quantity of vinegar, is, probably, phoſphoric acid from phoſphorated lime decompoſed by nitrous acid.

The precipitation by muriated barytes and nitrated ſilver could not be from vitriolic and marine acids conſiſtently with the preceding experiments; and I could not have conjectured what was the ingredient in JAMES's Powder which occaſions it, if I had not found, that muriated barytes is not only a teſt of vitriolic but of phoſphoric acid united to lime and alkalies; and the acid of phoſphorus will alſo produce a turbid appearance with nitrated ſilver. The calx of iron, in the above experiments, is in perhaps too ſmall a quantity to be conſidered in any other light than as an accidental ſubſtance.

II. *With acetous acid.*

The 260 grains of JAMES's Powder, remaining after boiling 300 grains of it in diſtilled water, and after the unavoidable waſte of it in the above experiments with water, were put into a tubulated retort that would contain four ounce-meaſures, on which were poured three ounces of concentrated acetous acid, the ſpecific gravity of which was as 106 to 100, the neck of the retort being immerſed in quickſilver, and the tubulated part being immediately cloſely ſtopped. No efferveſcence was perceived; nor did any elaſtic fluid riſe during twenty-four hours into an inverted veſſel of quickſilver; and when heat was applied to boil the acid, nothing but the common air of the retort and a little water and acetous acid came over.

This mixture of acetous acid and powder being poured, while hot, on a filter of two folds of paper, a clear and colourlefs liquid paffed through, that remained fo, when cold, without any fediment. The filter, with the powder upon it, being well dried, weighed ten grains more than the fum of their weight feparately before the experiment; but the powder being carefully fcraped off weighed only a little more than 240 grains, and appeared to have fuffered no change in its properties.

This filtered liquor was fubjected to diftillation; it remained clear till about half of it had come over: but then it became rather turbid, and grew more fo to the end of the diftillation. There remained in the retort apparently four or five grains of brown fediment, that adhered very clofely to the bottom and fides of it, nearly half as high as the liquid reached.

1ft, This acetous acid, in which JAMES's Powder had been boiled, and afterwards diftilled, was found to contain no earth, falt, or metallic matter: nor did the acid itfelf appear to be altered in its chemical qualities.

2dly, The refiduum in the retort had no tafte. It did not appear to diffolve by trituration in one ounce of diftilled water, nor in lixivium of alkali of tartar, mild or cauftic. After boiling this refiduum in one and a half ounce of water, part of it feemed to be diffolved; and this folution being filtered was examined with the following re-agents.

(*a*) Acid of fugar rendered it turbid, and tranfparency did not enfue on adding a further quantity of this acid.

(*b*) Muriated barytes produced a confiderable turbidnefs, which was not removed by adding concentrated acetous acid.

(*c*) Nitrated filver induced a flight turbid appearance.

(*d*) Mild alkalies induced no vifible change.

(*e*) Pruffianated

(*e*) Pruffianated foffil alkali occafioned a very flight opal coloured appearance, and after ftanding fix days a very fmall quantity of whitifh fediment was thrown down, which diffolved on concentrated acetous acid being added, and the liquid turned greenifh; but, after ftanding, a little greenifh fediment was depofited, not, however, apparently more than was produced by a mixture of this Pruffian alkali, acetous acid, and water.

(*f*) Phofphorated foffil alkali produced no turbidnefs or precipitation on ftanding a week; but on the addition of $\frac{1}{100}$ gr. of nitrated mercury (which had been made by fully faturating the nitrous acid with mercury) the mixture grew inftantly thick, and depofited a copious white fediment.

3dly, The remainder of the refiduum, in the retort above mentioned to have been left after diftilling to drynefs acetous acid in which JAMES's Powder had been boiled, did not totally diffolve in a large proportion of nitrous acid diluted; but was wholly taken up on adding a little marine acid. A great part of the fuperabundant acid of this folution being carried off by evaporation, it was examined with the following fubftances.

(*a*) Adding a little of it to a large proportion of water, milkinefs enfued.

(*b*) The fame appearance took place with a large proportion of lime-water.

(*c*) A turbid bluifh colour was produced on adding Pruffian mineral alkali, and on ftanding a bluifh fediment took place.

(*d*) A polifhed copper plate was not at all whitened by immerfion in this folution; but, on adding to it $\frac{1}{400}$ of a grain of nitre of mercury, the copper was rendered paler coloured.

The deficiency of twenty grains of powder in thefe experiments with acetous acid muft be afcribed partly to the

 folution

solution in this menstruum, and still more to the waste in the paper filter, and to its adhering to the retort when first boiled.

These experiments indicated the same kind of substances as the experiments with water, namely, calcareous earth in a combined state; phosphoric acid; calx of antimony and of iron. It appears also, that JAMES's Powder is either wholly or partially soluble in about 300 times its weight of concentrated acetous acid.

III. *With nitrous acid.*

The 240 grains of powder remaining after the experiments with acetous acid, p. 327. were digested in the cold twelve hours, in three ounce measures and a half of purified and concentrated nitrous acid, diluted with four ounces of pure water, and then distilled with a gentle heat till there remained about two ounce measures. After standing twenty-four hours, about one ounce and a half of clear liquid, which was very corrosive and acid, was drawn off by means of a syphon. The turbid liquid and close white sediment remaining, being mixed with one ounce of distilled water, were poured upon a filter of paper, and hot distilled water was repeatedly poured upon this filter till it passed through almost tasteless. The first portions of the filtered liquid, in quantity ten ounces, being mixed together, were set to evaporate in a glass pan. As soon as the liquor grew hot, the turbidness disappeared; and as the evaporation went on, first clouds, and afterwards portions of sediment, appeared in a clear liquid. The evaporation being continued nearly to dryness, a white, porous, or cellular cake was left, that weighed 129 grains. The liquid obtained

by diſtillation from the ſolution which left this maſs was found to be merely diluted nitrous acid.

The reſiduum left on the filter which had reſiſted ſolution in nitrous acid, being well dried, weighed a little more than 142 grains. This reſiduum was digeſted, and boiled as before in nitrous acid; and this menſtruum, diſtilled from the reſiduum, being evaporated to dryneſs, afforded 6,5 grains of a whitiſh maſs. The reſiduum left on the filter after this ſecond application of nitrous acid, being well dried, weighed 132 grains.

The maſs of 129 grains, left on evaporation of the above ſolution of JAMES's Powder in nitrous acid, in a few hours began to deliqueſce, eſpecially at the edges. Some of the deliqueſcing part of the maſs was diſſolved in one ounce and a half of water, forming an opal-coloured ſolution, with a white ſediment. This opal-coloured ſolution being filtered was examined.

(*a*) It rendered lime-water milky; and the milkineſs did not diſappear on adding concentrated acetous acid, but readily on pouring into the mixture a little acid of nitre.

(*b*) It turned thick and white, and ſoon depoſited a copious ſediment of white matter, with a few drops of nitrous ſolution of mercury; and became turbid alſo with nitrated ſilver.

(*c*) With muriated barytes it became very turbid, and remained ſo after adding acetous acid; but grew clear again on adding nitrous acid.

(*d*) Acid of ſugar produced a turbid appearance.

(*e*) Cauſtic volatile alkali produced very little precipitation; but a copious one took place with mild alkali of tartar; which precipitated matter, after decanting the clear ſolution, was nearly all diſſolved by acetous acid, and the remainder was readily taken up by the marine as well as by the nitrous acid.

(*f*) Pruſſian

(*f*) Pruſſian alkali occaſioned a light blue colour, but no turbid appearance till the mixture had ſtood ſeveral days, which was then ſlight.

(*g*) No change of colour was produced on a copper plate.

A little of the ſoft and deliqueſcing part, juſt mentioned to have taken place at the edges of the ſolid maſs, taſted bitter and ſour. It melted under the blow-pipe into a horny kind of globule; but the dry part of this maſs could not be fuſed by this means.

This ounce and a half of ſolution being conſumed in theſe trials, the ſame quantity of boiling diſtilled water was poured on the precipitate or part not diſſolved by this quantity of water on the firſt affuſion. After ſtanding and boiling, the precipitate appeared to be but little diminiſhed. The clear liquid did not as before render lime-water turbid; but a precipitate enſued with nitrated mercury, which on compariſon was found to be a more delicate teſt of phoſphoric acid than lime-water. This ſolution alſo, by this ſecond affuſion of water, did not as before grow thick with mild alkali of tartar, nor blue with Pruſſian alkali. The ſediment, undiſſolved by theſe two applications of water, did not totally diſſolve in a ſuperabundant quantity of nitrous acid; but completely and immediately in a ſmaller quantity of marine acid; and this ſolution in marine acid, with a large proportion of water, produced milkineſs; with Pruſſian alkali, it turned of a deep blue colour; it did not whiten copper; ſaccharine acid and ſalited barytes only ſlightly diſturbed its tranſparency.

By theſe experiments I found the ſolution of JAMES's Powder in nitrous acid contained, probably, a pretty conſiderable proportion of calcareous earth united to both nitrous

and phoſphoric acid; a little phoſphoric acid in a free ſtate; and a ſmall proportion of calx of antimony and of iron.

Ninety grains of the dry part of the above maſs of 129 grains, p. 329. were repeatedly triturated and digeſted in alcohol till almoſt nothing was taken up by it. This ſolution, being filtered, was evaporated to dryneſs, and afforded 20 grains and a half of a fine white ſalt, very bitter, which, on expoſure to the air, ſoon became liquid, but very turbid.

The powder that had thus ceaſed to yield any thing further to alcohol was repeatedly triturated and boiled in pure water, till the liquid paſſed taſteleſs through the filter; and the filtered liquors, being evaporated, left eight grains more of a leſs bitter and leſs deliqueſcent ſubſtance than that from alcohol. Part only of theſe eight grains was ſoluble readily in water; and they appeared to be a mixture of the ſaline matter diſſolved in alcohol, and of the inſoluble reſiduum in that menſtruum.

The powder remaining on the filter after theſe ſolutions in alcohol and water being dried, weighed nearly 59 grains. It was white and taſteleſs.

I next examined theſe products more particularly; and *firſt* the twenty grains and a half which had been diſſolved in alcohol.

(*a*) With a large proportion of water it produced a rather turbid appearance, and, after ſtanding, a ſediment of calcareous earth was depoſited.

(*b*) This laſt ſolution (*a*) being filtered, with mild alkalies grew very thick, and depoſited a ſediment that was readily taken up by acetous acid.

(*c*) With cauſtic volatile alkali its tranſparency was ſcarcely diſturbed.

(*d*) With acid of ſugar it became thick and white; and

(*e*) White

(*e*) White as cream of milk with phosphorated mineral alkali; the sediment from which mixture did not dissolve in a quantity of boiling water that would have dissolved vitriolated lime, nor in vinegar, but was readily taken up by nitrous acid.

(*f*) The transparency of nitrated and muriated barytes was scarcely disturbed.

(*g*) It turned infusion of turnsole red.

(*h*) A little of the deliquescent salt above mentioned, that had been dissolved in alcohol, being made nearly dry, on adding to it a mixture of alcohol and acid of vitriol, vapours of nitrous ether were detached with ebullition

(*i*) With lime-water it produced a slight sediment.

(*k*) With Prussian alkali at first a pale green colour, and afterwards a blue colour was produced; but without any precipitation on standing.

(*l*) This substance, which had been dissolved in alcohol, was infusible under the blow-pipe; and after being heated red-hot on charcoal it was no longer soluble in water. Being further examined, it was found to be merely calcareous earth.

This soluble part then in alcohol appeared to be nothing but nitrated lime, with some traces of calcined iron.

Secondly, The 59 grains of powder, not soluble in alcohol, were examined.

(*a*) A mixture of vitriolic acid and alcohol detached from this powder no nitrous ether, nor any vapour that formed white clouds with volatile alkali.

(*b*) It did not effervesce, and required above 200 times its weight of concentrated acetous acid to dissolve it.

(*c*) Under the blow-pipe it emitted no smell or fume, and with great difficulty melted imperfectly, affording an irregular figured, horn-like, opaque mass.

(*d*) It

(*d*) It was not diminiſhed or altered in its properties by boiling in lixivium of alkali of tartar.

(*e*) Nitrous acid formed with it, without efferveſcence, a very ſlightly turbid ſolution; which ſolution produced the ſame appearances as thoſe related, p. 330, 331.

(*f*) 50 grains of this powder were diſſolved in nitrous acid, and a great part of the redundant acid being carried off by evaporation, to one half of this ſolution was added lime-water till it ceaſed to produce any milkineſs, and the mixture taſted of lime-water. After ſtanding excluded from the air, the ſediment depoſited from a clear liquid was collected, and being dried it weighed 26,3 grains. This precipitate had the properties of phoſphorated lime, with that proportion of lime and phoſphoric acid which forms a compound ſcarcely fuſible. The liquid in which this precipitate fell ſeemed to contain a little phoſphorated lime, but principally calcareous earth.

(*g*) To the other half of this ſolution in nitrous acid (*f*) was added vitriolic acid, drop by drop, till it no longer diſturbed its tranſparency. After ſtanding, the clear liquid was decanted from the precipitated matter which had taken place, and the precipitate with a ſmall quantity of water was thrown upon a filter. The filtered and decanted liquids mixed together were boiled till the ſmell of nitrous acid ceaſed, and there remained about half an ounce of acid liquor, which being filtered to ſeparate the vitriolated lime precipitated during evaporation, foſſil alkali was added to perfectly ſaturate it. During this union there was an efferveſcence and a ſeparation of more vitriolated lime, which being removed, the ſaturated liquor, by cryſtallization, afforded nearly 26 grains of cryſtals of phoſphorated foſſil alkali, be-

ſides

fides a little cubic nitre, vitriolated foffil alkali and iron, with fome veftiges of calx of antimony, and phofphorated lime.

The precipitate thrown down on adding vitriolic acid, and left upon the filter, weighed when dried 26,1 grains, and was vitriolated lime, with a minute portion of calcined antimony and iron.

The 6,5 grains, p. 330. left on evaporation to drynefs of the fecond folution in nitrous acid, confifted of nearly three grains of calcined antimony, and the reft phofphorated lime, with a little iron.

1. It appears from the above experiments with nitrous acid, that this menftruum, by two affufions, in a large proportion, aided by trituration, digeftion, and heat, diffolved $\frac{108}{240}$ of JAMES's Powder that had been expofed to the action of water and acetous acid; but from the fmallnefs of the quantity contained in the nitrous acid the fecond time it was applied, and from its being principally calcined antimony, not more than two of the fix grains afforded by this folution, perhaps, fhould be confidered to be *diffolved*, for the reft may be fuppofed to be merely *fufpended*.

The firft folution alfo in this menftruum was not filtered, and the acid was confiderably redundant, and there was found in it feveral grains of calcined antimony. The real quantity *diffolved* might therefore probably be eight grains lefs than the above 108 ftated. According to this mode of calculation, the proportion of the foluble part of JAMES's Powder in nitrous acid is $\frac{100}{240}$, or about $\frac{41}{100}$.

2. The whole of this foluble part, except a little calx of antimony, is, decifively, phofphoric acid and calcareous earth: which

which two ſubſtances may reaſonably be ſuppoſed, from theſe experiments, to have been united together, and to have been in the ſtate of phoſphorated lime in this powder. Conſequently, the proportion of this phoſphorated lime, conſidered as the ſoluble part of JAMES's powder in theſe experiments with nitrous acid, appears to be 40 *per cent.* making a deduction of 1 *per cent.* for the antimonial calx contained in the nitrous acid in the above experiments. It is however already obvious to ſuſpect, that the powder which reſiſted ſolution in this menſtruum may contain more phoſphorated lime; and this conſideration prevents me aſſigning at preſent the above 40 *per cent.* as the whole quantity of it in JAMES's Powder. It cannot however, I think, be a ſmaller proportion.

I do not reckon the calx of iron in theſe calculations, becauſe it is in too ſmall a quantity, and is apparently only to to be looked upon as an accidental extraneous ſubſtance. I ſuppoſe too, that the water and acetous acid applied to the JAMES's Powder uſed in theſe experiments, carried off a proportion of its ingredients equal to that in the remaining powder.

IV. *With marine acid.*

The 132 grains of heavy, white, taſteleſs powder, the reſiduum after boiling 240 grains of JAMES's Powder in nitrous acid, till it had diſſolved that part for which it has any conſiderable affinity, p. 330. were digeſted for twenty-four hours in eight ounce-meaſures of marine acid, the ſpecific gravity of which was 1,170, and diluted with half its bulk of diſtilled water. This mixture was diſtilled in a

gentle heat till there remained about two ounce-meaſures of a very turbid liquor. After ſtanding in a jar two days, it depoſited a cloſe white ſediment, obviouſly much leſs in bulk than the powder added to this menſtruum; and nearly one ounce meaſure and three quarters of clear yellow liquid were drawn off, by means of a ſiphon, which was marked N° 1.

The diſtilled liquid, which was merely diluted marine acid, was poured back on the ſediment and remaining liquid; and after digeſtion twenty-four hours, this mixture was diſtilled as before, till there remained about one and a half ounce-meaſure; but after ſtanding in a jar ſeveral days, the quantity of ſediment depoſited was apparently as great as before the ſecond application of this menſtruum. The clear liquor was drawn off as before, and marked N° 2. The diſtilled liquor being found to be merely diluted marine acid, was poured on the remaining liquid and ſediment a third time; and, after digeſtion, the diſtillation was repeated as before. The remaining liquid having ſtood upon the ſediment ſome time, one ounce-meaſure of clear liquor was drawn off, and marked N° 3. The ſediment did not appear diminiſhed by this third diſtillation; but, as the decanted liquid, N° 3. was found to contain a ſmall quantity of ſome ſubſtance diſſolved or ſuſpended in it, the marine acid diſtilled in this experiment was poured a fourth time on this reſiduum, and after digeſtion boiled. Having ſtood ſeveral days, the clear liquor was decanted, and marked N° 4. To the reſiduum, after theſe four affuſions of marine acid, one ounce of boiling diſtilled water was added, and this mixture was poured on a filter. The powder upon the filter being well dried, was found to weigh 60,1 grains.

In the ounce of boiling water that had been filtered from this refiduum, I could find nothing but fome minute particles of that fubftance and veftiges of iron. Two or three drops of the liquor, N° 1. added to three ounces of diftilled water, produced a pretty confiderable milkinefs; and, on ftanding, a clofe white fediment was depofited. Two or three drops of the liquor, N° 2. produced lefs milkinefs and fediment in the quantity of water juft mentioned than N° 1. N° 3. fcarcely diminifhed the tranfparency of diftilled water; and N° 4. did not affect it all. The liquids, N° 3. and 4. were diftilled till there remained about two drachm-meafures of clear brown liquid, with a cloudy fediment. N° 3. being poured into two ounces of diftilled water fcarcely made it milky; and N° 4. did not diminifh the tranfparency of water at all. On evaporating to drynefs thefe mixtures of the liquors, N° 3. and 4. with diftilled water; that with N° 3. left a yellowifh dry fediment which weighed 3,1 grains; and that of N° 4. left 2,2 grains of fediment. Nothing but calx of antimony could be difcovered in thefe fediments. They were reducible readily with tartar; fcarcely fufible in the fpoon; but with phofphoric acid eafily melted into an opaque yellowifh globule.

The liquor, marked N° 1. being poured into twenty-four ounces of diftilled water produced a very milky appearance; and the fame appearance, but in a much lefs degree, enfued on pouring the liquor N° 2. into this quantity of pure water. After ftanding feveral days, a white fediment being depofited from a clear watery fluid, the clear liquid was drawn off by means of a fiphon, and the fediments being dried, that of N° 1. weighed 51 grains; that of N° 2. weighed 6,15 grains; and both were found to be purely Algaroth powder. The water, *viz.* 48 ounces, in which thefe precipitates fell, being

evaporated

evaporated to dryneſs, left a little more than four grains of an infuſible kind of ſediment, which was calx of antimony, like that of N° 3. and 4. with a minute portion of Algaroth powder and iron.

The 60,1 grains, p. 337. which reſiſted ſolution in marine acid, were a lighter powder than JAMES's Powder itſelf, rather gritty, quite taſteleſs. This powder was digeſted in one-ounce meaſure of concentrated nitrous acid mixed with two of acid of ſalt for a week; and then this mixture was diluted with four ounces of diſtilled water, and gently boiled till it was reduced to about two ounce-meaſures. On cooling and ſtanding ſeveral days, a ſediment of the ſame kind apparently, and in the ſame quantity as before evaporation, was depoſited, and, after ſtanding, a clear yellow liquid was drawn off. The ſediment, well dried, weighed 55 grains. The decanted liquor being reduced by evaporation from one and a half ounce to about two drachm-meaſures, a ſediment, while hot, appeared, which was calx of antimony, with a minute portion of earthy matter that had ſome properties of phoſphorated lime and calx of iron. A little of the clear liquor on this ſediment being dropped into water produced no milkineſs, nor ſediment, after ſtanding; but the whole of this clear liquor, with ſediment, being evaporated to dryneſs, afforded four grains of the ſame kind of infuſible calx of antimony, mentioned to have been obtained from the acid liquors, N° 3. and 4. above mentioned.

It appears then, that by repeatedly digeſting and boiling in marine acid, and in *aqua regia*, that part of JAMES's Powder which reſiſted ſolution in nitrous acid, which was $\frac{132}{240}$, p. 335. 77 grains were carried off by theſe menſtrua; but conſidering the ſmall proportion contained in theſe acids after the two firſt

 affuſions,

affufions, which afforded 57,15 grains, p. 338., and fuppofing the calx to be neither increafed nor diminifhed in weight by the acids, the real quantity of foluble and fufible calx of antimony may be ftated to be that of Algaroth powder; for the other kind of antimonial calx obtained by fubfequent affufions was probably only *fufpended.* Confequently 240 grains of JAMES's Powder afforded, by the above experiments with marine acid, 57,15 grains of Algaroth powder, and 19,85 grains of a lefs foluble and more difficultly fufible calx of antimony, with a fmall proportion of phofphorated lime. The refiduum, amounting to 55 grains, was of courfe next examined.

Experiments upon the part of JAMES's *Powder which was infoluble in the above menftrua.*

(*a*) A few grains of this infoluble fubftance could neither be melted nor carried off in vapour by means of the flame of a candle applied to it upon charcoal, and alfo in the fpoon, with the blow-pipe; but,

(*b*) Mixed with an equal weight of tartar, it melted on charcoal; and, while in fufion, fmall, apparently, metallic grains were diftinctly perceived; and on cooling they could be feen, even without a lens, adhering to an irregularly figured, opaque, whitifh mafs. Sometimes flight explofions were heard while the flame was applied. The metallic grains appeared more diftinctly when this powder was mixed with one-third of its weight of powdered calcined bone, than in JAMES's Powder.

(*c*) Ten grains of this powder were melted as above mentioned, by repeatedly applying flame with the blow-pipe to

two

two or three grains of it at a time mixed with tartar. The opaque whitish masses, with metallic grains in them, thus obtained, being pulverized, were digested and gently boiled in diluted nitrous acid. The filtered solution afforded nitre, and nitrous acid in a free state, the greatest part of which superabundant acid being carried off, the lixivium did not whiten copper, or throw down any calx but iron with Prussian alkali. The residuum that resisted solution in nitrous acid was digested and gently boiled in *aqua regia*. On standing it was decanted, and this decanted liquid being heated, to carry off superabundant acid and water, it afforded on mixture with water 1,2 grain of Algaroth powder, and no metallic matter could be detected in the water excepting a little iron. A small part only being dissolved by the *aqua regia*, the residuum was exposed to the flame of a candle with tartar as before; and, by the aid of a lens, I could just perceive two or three metallic grains in the fused mass. To this mass the *aqua regia* was again applied, and 0,15 grain of Algaroth powder was obtained, and no other metallic calx was found but iron. A third affusion of *aqua regia* indicated an exceedingly minute portion of Algaroth powder; but I could afterwards perceive no more metallic grains in the residuum exposed to flame with tartar, nor obtain more Algaroth powder from the solution of the fused mass in *aqua regia*. The residuum that resisted solution melted readily with a little phosphoric acid into an opaque, somewhat yellowish, white globule, not unlike calcined bone fused with phosphoric acid, and a minute portion of flowers of antimony. The quantity, however, of this residuum was so small, that I despaired of determining its nature further by more experiments.

Having

Having found that this inſoluble powder would not melt with ſulphur when heated *red-hot*, I made the following experiment.

(*d*) Twenty grains of it being mixed with three times its weight of ſulphur, were put into one of Mr. WEDGWOOD's crucibles that would contain one ounce-meaſure, which, with a cover well luted on, was put into a three-inch Engliſh crucible, and calcined bone in powder filled the ſpace between the two crucibles. After expoſing this charge to a red heat half an hour, and in a white heat ten minutes, the crucibles were cooled; and being opened, the pyrometer piece of WEDGWOOD in the bone aſhes was found to indicate 65°, and the mixture in the inner crucible had apparently been melted into a reſin-like maſs that adhered firmly to the ſides of the veſſel. Twenty-eight grains were ſcraped off, which, after digeſtion and boiling in marine acid, afforded ſix grains of Algaroth powder. A great deal of hepatic air was diſcharged during this ſolution, and very little ſulphur was left on the filter with the part not diſſolved by the marine acid. This undiſſolved part, which weighed ſix grains, was blackiſh, taſteleſs, not heavy. It was infuſible with the blow-pipe, both alone, and mixed with ſulphur and tartar; but with phoſphoric acid it melted into a blackiſh ſcoria-like maſs. I could only conjecture, that this laſt part was antimonial calx, ſo far vitrified with phoſphorated lime as to be neither ſoluble nor reducible or fuſible, except with phoſphoric acid.

(*e*) By a ſimilar experiment, but with alkali of tartar twenty grains, ſulphur thirty grains, and ten grains of this inſoluble part of JAMES's Powder, a fuſed maſs was obtained that partially diſſolved in water, and afforded kermes mineral on pouring an acid into this ſolution; but a great part was inſoluble

infoluble in water and acids, and feemed to be of the fame nature as the fix grains of refiduum juft mentioned (*d*).

I could only conclude from thefe experiments on this infoluble matter, that it contained calx of antimony; but as to the proportion of it, and the other fubftance with which it is joined, I conjecture that it may be about half the quantity of the infoluble powder; and that the other half is antimonial calx and phofphorated lime, fo highly calcined and vitrified together as to refift folution in acid menftrua, decompofition by charcoal, and fufion with fixed alkalies, but not by phofphoric acid.

I fhould not have been fatisfied with here terminating this analyfis without enquiring further into the nature of this infoluble matter; but I difcontinued this analytic inveftigation in order to derive light from the fynthetic experiments which will be related hereafter.

Thefe laft experiments feem to fhew, that the proportion of antimonial calx is not fo great as might have been affigned from the experiments with nitrous acid, marine acid, and *aqua regia.*

The fubftances and proportions of them, obtained from 240 grains of JAMES's Powder, by the above experiments, are as follow:

	Grains.
Phofphorated lime, with a little antimonial calx,	100,
Algaroth powder, ...	57,15
Infoluble antimonial calx, with a little phofphorated lime, ...	19,85
The fame infoluble calx, with, probably, a little phofphorated lime, ...	55,
Wafte, ...	8,
	240,0

3 As

As it may be objected, that concluſions drawn concerning the nature of calces might be erroneous if nitrous acid had been applied previouſly to ſubſtances containing them, I made the following experiment.

Experiment with marine acid applied to JAMES'S *Powder, which had not been expoſed to the action of nitrous acid, or any other menſtruum.*

50 grains of JAMES'S powder were digeſted, and gently boiled in two ounce-meaſures and a half of concentrated marine acid diluted with one ounce of diſtilled water till there remained only about one ounce-meaſure. A great part of the powder appeared to be evidently diſſolved. On cooling, cryſtals of muriated antimony were formed upon a white ſediment. The clear liquid with the cryſtals being decanted, the ſediment was boiled twice, as before, with marine acid; but the ſecond affuſion of this menſtruum brought off but eight grains of this powder, and the third only four grains. The remaining ſediment, being well dried, weighed 14 grains. Now it has been ſhewn already, that the nitrous and marine acids, ſucceſſively applied, diſſolved $\frac{177}{240}$, or all but about 60 grains; and in the preſent experiment, the marine acid diſſolved $\frac{36}{50}$, which is in the proportion of $\frac{180}{250}$, or nearly $\frac{173}{240}$; ſo that, on account of the trifling difference in theſe proportions, it may, perhaps, be fairly concluded, that the properties of the calx in JAMES'S Powder are not altered by nitrous acid to affect its ſolubility in marine acid. And further, this inſoluble powder in the preſent experiment was found to have the ſame properties as that in the former experiments.

To

To know whether JAMES's Powder contained any subftance that could be decompofed by mild fixed alkalies, the following experiments were made.

Thefe experiments with fixed alkali feemed to be efpecially neceffary, becaufe phofphoric acid, lime, and antimonial calx, are ingredients in JAMES's Powder; and it was obvious to fufpect, that this acid might be united with calx of antimony as well as with lime; which phofphorated antimony would be decompofed by alkalies, and yield phofphorated alkali.

Experiments with fixed alkalies.

100 grains of JAMES's Powder were boiled in fix ounces of water, with 50 grains of mild alkali of tartar, for three hours, and then the remaining liquid was filtered, and evaporated to drynefs; but the matter left after evaporation was nothing but the alkali ufed in the experiment, with a little of the powder itfelf.

The refult was the fame on making the experiment with cryftallized mineral alkali inftead of alkali of tartar.

Synthetic Experiments.

ALTHOUGH the inability to prepare JAMES's Powder would not prove the above conclufions, with refpect to its compofition, to be erroneous; the being able to compofe a fubftance

 poffeffing

poffeffing all the fame properties as JAMES's Powder, by uniting or mixing together the fubftances fhewn by the above analyfis to enter into its compofition, would afford all the proof and demonftration which can be had in the fcience of chemiftry.

The above analyfis fhewed no effential ingredients of JAMES's Powder but antimonial calces, phofphoric acid, and calcareous earth, which two laft fubftances appeared to be united together; but it would have been vain and unneceffary labour to have attempted to make this powder by mixtures of any of the commonly known calces of antimony and phofphorated lime; becaufe none of them, from their well known qualities, could form a powder of the fame colour and fpecific gravity as JAMES's Powder, and like it partially foluble in acids. From the above experiments, however, the probability was evident, that this fubftance might be made by calcining together antimony and bone-afhes; which operation produces a powder called LILE's and SCHAWANBERG's fever-powder; a preparation defcribed by SCHRODER and other chemifts 150 years ago. The receipts for this preparation differed in the proportion of the antimony to the bone afhes, and in the ftate of the bone; fome directing bone fhavings to be previoufly boiled in water; others ordered them to be burnt to afhes before calcining them with antimony; and in other prefcriptions the bone fhavings were directed to be burnt with the antimony. According to the receipt in the poffeffion of Mr. BROMFIELD, by which this powder was prepared forty-five years ago, and before any medicine was known by the name of JAMES's Powder, two pounds of hart's horn fhavings muft be boiled to diffolve all the mucilage, and then, being dried, be calcined with one pound of crude antimony, till the fmell of

fulphur

fulphur ceafes; and a light grey powder is produced. The fame prefcription was given to Mr. WILLIS, above forty years ago, by Dr. JOHN EATON, of the College of Phyficians, with the material addition, however, of ordering the calcined mixture to be expofed to a great heat in a clofe veffel to render it *white*. Mr. TURNER made this powder above thirty years ago by calcining together equal weights of burnt hart's horn and antimony in an open veffel, till all the fulphur was driven off, and the mixture was of a light grey colour. He likewife was acquainted with the fact, that by a fufficient degree of fire in a clofe veffel this cineritious powder turned *white* *. Mr. TURNER alfo prepared this powder with a pound and a half of hart's horn fhavings and a pound of antimony, as well as with fmaller proportions of bone. SCHRODER prefcribes equal weights of antimony and calcined hart's horn; and POTERIUS and MICHAELIS, as quoted by FREDERIC HOFFMAN, merely order the calcination of thefe two fubftances together (affigning no proportion), in a reverberatory fire for feveral days. In the London *Pharmacopœia* of 1788, this powder is called *Pulvis antimonialis*; and it is directed to be prepared by calcining together equal weights of hart's horn fhavings and antimony.

Powders made from various proportions of antimony and bone-afhes, after folution in nitrous acid, left a refiduum of antimonial calx much lefs or greater in quantity than JAMES's Powder did by the fame menftruum, except two of Mr. TUR-

* It is probable, that this powder was made for feveral years with merely the heat neceffary to carry off the fulphur and calcine the bone, in an open veffel over a charcoal fire in a common grate, and confequently it was of a light clay or afh colour. In this manner, Mr. BROMFIELD told me, he prepared SCHAWANBERG's Powder 46 or 47 years ago. Its property of turning *white* in a greater degree of fire appears to have been a fubfequent difcovery.

NER's proportions, *viz.* two parts of antimony and one of calcined bone, and equal weights of bone ſhavings and antimony. The quantity of this calx was, however, greater in the powder from the former of theſe two laſt proportions than the latter of them; which latter correſponded ſometimes exactly, and always nearly, with the weight of the calx from a given weight of JAMES's Powder. This calx afforded alſo the ſame proportion of Algaroth powder as the calx in JAMES's Powder; and the inſoluble part of the calx afforded metallic grains like thoſe from the inſoluble part of the calx in that powder.

I found then an exact correſpondence between what I conſider to be the eſſential and peculiar properties of JAMES's Powder, and the properties of a powder made by uniting or mixing together the ingredients of JAMES's Powder found by analyſis. But, in order to ſhew the identity or difference of the qualities of theſe two ſubſtances, I made comparative obſervations on them, and repeated the above analytic experiments on JAMES's Powder with the preparation made by calcining together equal weights of bone ſhavings and antimony, in an open veſſel, to carry off the ſulphur, and then in cloſe veſſels applying ſuch a degree of fire as to render them *white*, that is, on the ſame preparation as the *Pulvis antimonialis* of the London *Pharmacopœia*.

Firſt, I compared, more particularly, the ſenſible qualities of ſeveral different ſpecimens of JAMES's Powder with various parcels of the *Pulvis antimonialis* made by different chemiſts. All of theſe would be called white powders, but not two of them were ſo in the ſame degree. Moſt of the papers of the *Pulvis antimonialis* were whiter than thoſe of JAMES's Powder; but others were of a very light ſtone colour, and ſome had a ſhade of yellow, ſo as to reſemble very exactly JAMES's Powder;

but

but all the parcels of JAMES's Powder had either a ſhade of yellow or of ſtone colour, and none were perfectly white, or ſo white as ſome ſpecimens of the *Pulvis antimonialis*. Some of the parcels of JAMES's Powder and of the *Pulvis antimonialis* taſted braſſy; and other ſpecimens of both powders had no taſte. All of theſe powders were gritty. Moſt of the parcels of the *Pulvis antimonialis* were a little ſpecifically heavier than thoſe of JAMES's Powder. The ſpecific gravity of both powders was increaſed by expoſing them to ſuch a degree of fire as brought them into almoſt a ſemi-vitrified ſtate; and, on the contrary, the ſpecific gravity of the *Pulvis antimonialis* was leſs than it is in its uſual ſtate, when made in ſuch a degree of fire that the mixture preſerves the powdery form.

The experiments with water on the *Pulvis antimonialis* produced the ſame kind of appearances, but more ſlightly than thoſe with JAMES's Powder; for the hot ſolution of the former grew leſs milky on cooling than that of the latter, and on evaporation to dryneſs leſs ſediment was found of the ſolution of *Pulvis antimonialis* than after that of JAMES's Powder *.

The experiments with acetous acid on the *Pulvis antimonialis* ſhewed, that this menſtruum diſſolved ſometimes a greater, and ſometimes a ſmaller proportion of it than of JAMES's powder; and the diſſolved matter was found to be antimonial calx, phoſphorated lime, and calx of iron, and no other ſubſtance.

It has been already ſaid, that the proportion of ſoluble matter in nitrous acid was the ſame, or nearly ſo, of the *Pulvis antimonialis* as that of JAMES's Powder; and this diſſolved matter was phoſphoric acid, calcareous earth, with a little antimonial calx, and a minute portion of calx of iron, as exactly

* The reaſon for this difference is aſſigned in another place.

as

as could be expected from the nature of the ſubſtances and the experiments, in the ſame proportion as thoſe in JAMES's Powder.

The Algaroth powder, obtained by means of ſolution of the *Pulvis antimonialis* in marine acid, was in the ſame proportion as nearly as could reaſonably be expected from the nature of the experiments as that obtained from JAMES's Powder. And the part that reſiſted ſolution in this menſtruum was partially reducible to a metallic form, and had otherwiſe the ſame properties, as far as diſcovered, as the inſoluble part of JAMES's Powder.

Having now formed a powder poſſeſſed of properties ſimilar in *kind* to every one of thoſe aſcertained in JAMES's Powder, with ſcarcely any difference in the *degree* of them, if it be thought that among theſe properties are thoſe which are eſſential and peculiar ones of JAMES's Powder, the concluſion that theſe two are the ſame kind of things muſt be admitted to be juſt. The nature of one of the ingredients of JAMES's Powder, *viz.* the irreducible part of the inſoluble matter, p. 342. is not fully elucidated by the ſynthetic experiments; but in ſo far as they ſhew, that this part equally exiſts in the powder formed by calcining together antimony and bone, which is concluded to be JAMES's Powder, the objection againſt the concluſion with reſpect to the identity of the two ſubſtances, on the ground of this inconſiderable part of JAMES's Powder not being well underſtood, muſt be of little weight.

Several reaſons, more intereſting to myſelf than to the Society, induced me to authenticate by additional teſtimonies thoſe analytic experiments, which may be conſidered to be more deciſive than the reſt for eſtabliſhing the identity of JAMES's Powder, and a powder formed by calcining together antimony and bone-aſhes. I therefore requeſted Mr. CAVALLO and Mr. TURNER to be

present when I made those experiments on the *Pulvis antimonialis*, prepared by Mr. GRIFFIN, of Apothecaries' Hall, and JAMES's Powder. Having, in the presence of these two Gentlemen*, broken the seal of a phial of JAMES's Powder, bought of F. NEWBERY, and taken out of it the quantity required for the experiments, the bottle was again sealed by Mr. CAVALLO with his seal, as well as the phial from which was taken the *Pulvis antimonialis*. Should any experiments be published, which establish different conclusions from those contained in this Paper, with respect to the identity of these two powders, I shall be happy to endeavour to ascertain the truth by experiments, on the remaining parcels of the two powders, in the presence of competent judges.

I shall next relate the experiments made with the view of confirming or invalidating the conclusions drawn from the above analysis, with respect to the ingredients and proportions of them in JAMES's Powder; and by which I especially endeavoured to make such antimonial calces as this substance contains, by processes different from those above related.

EXP. I. (*a*) Hart's horn shavings, of six different parcels, well dried, separately calcined in the same manner, and apparently to the same degree as when calcined with antimony to make LILE's Powder, afforded a light brown coarse powder, with a few thin light black pieces, and lost from 43 to 48 *per cent.* of their weight. The mean loss of weight, of course, was $45\frac{1}{2}$ *per cent.*

(*b*) This calcined bone (*a*), being pulverized, was exposed to a greater degree of fire, in close vessels, than that necessary to render the calcined mixture of antimony and bone-ashes *white*. The loss of weight by this second calcination or exposure to fire was from two to three *per cent.*; and the ashes

* Dr. CLARKE also was present at the beginning of these experiments.

were

were as white as ſnow. The total mean loſs of weight, by theſe two calcinations, was then $\frac{48}{100}$.

EXP. II. 2000 grains of coarſely powdered antimony were calcined in an earthen diſh, as in making LILE's Powder, by conſtantly raking them about for above three hours. During a great part of this time the veſſel was red hot at the bottom; and for the laſt hour the ſulphureous fumes had entirely ceaſed. The calx thus produced was of a pale bluiſh colour; it melted, in a low degree of heat, into an opaque, ſcoria-like brittle maſs; it yielded no hepatic air with marine acid; it weighed 1409 grains, or the antimony loſt nearly $29\frac{1}{2}$ *per cent.* The pyrometer in the veſſel with the antimony during its calcination, was contracted to the 6th degree of WEDGWOOD's ſcale.

The ſum therefore of the loſs of antimony and bone by calcination in this manner, ſeparately, was $37\frac{1}{2}$ *per cent.* Theſe two ſubſtances were in the next place calcined together in the ſame manner in an open veſſel, as above mentioned.

EXP. III. 2000 grains of antimony from the ſame parcel as that in the laſt experiment, and an equal weight of hart's horn ſhavings taken from the ſame parcel as thoſe were in Exp. I. were calcined together in the ſame manner that theſe ſubſtances had been ſeparately. During the firſt quarter of an hour, the mixture ſmoked, was black, ſmelled ſtrongly of ſulphur, and felt ſoft. For half an hour more, the ſmell of ſulphur continued, the mixture turned brown, and the bone was reduced to aſhes. At the end of this time, not only the bottom of the veſſel might be kept red hot without any ſigns of fuſion; but the ſmell of ſulphur, though weakly, continued for half an hour more in a heat to keep a great part of the mixture red hot. At this time the ſulphureous ſmell rather ſuddenly diſappeared, and could not be perceived, though a

little

little of the mixture was made quite red hot for a quarter of an hour further; during which no fume was seen, or smell perceived. After cooling, a light grey or cineritious heavy powder was left; on examining which, argentine *spicula* were seen in the larger grains of this calcined substance. It weighed 2200 grains, therefore the loss of weight was 45 *per cent.* The WEDGWOOD pyrometer pieces indicated 8°. In other similar experiments the loss, by calcination, was from 37 to 41 *per cent.*; therefore the mean proportion lost in these experiments must be stated at 41 *per cent.*

It appears, that the calcination of antimony with bone-ashes is much more speedy than when by itself, but the degree of fire was a little greater in the last experiment than in that with antimony alone. Considering the nature of these experiments, perhaps, it may be more reasonable to impute the $3\frac{1}{2}$ *per cent.* greater loss in this last experiment than the sum of the loss in Exp. 1. and 2. to the greater insensible sublimation of the calx from more fire in one case than in the other, than to refer it to the larger quantity of air combined with the metal in the former of these two last experiments.

EXP. IV. The above light clay or ash-coloured powder, obtained in the last experiment by calcining together antimony and bone, being exposed to various degrees of fire from 20° to 165° of WEDGWOOD'S pyrometer, in close crucibles, was not at all increased in weight, but generally lost about 5 *per cent.* when a pretty large quantity, as a pound, was in the vessel. A part of this loss must be referred to the adhesion or vitrification of the charge with the sides of the crucible, and part to the deficiency of the bone itself, as above shewn, by further exposure to fire. I am sensible, that in experiments of this nature all calculation must necessarily, to a certain degree,

 be

be vague; yet it may be of ſome application to obſerve, that the proportion of antimonial calx, eſtimated to be contained in LILE's Powder or *Pulvis antimonialis*, and JAMES's Powder, p. 343. from the analyſis of them, does not differ more conſiderably from the proportion of this calx than may, perhaps, be reaſonably expected on calculation from theſe four laſt experiments to exiſt in them: for $70\frac{1}{2}$ parts of antimonial calx, p. 352. to $54\frac{1}{2}$ parts of bone-aſhes, p. 351. is as about 56,4 parts of this calx to 43,6 parts of calcined bone; and, on analyſis, JAMES's Powder afforded $\frac{57}{100}$ of antimonial calx, and $\frac{43}{100}$ of phoſphorated lime, or nearly ſo, p. 343. allowing for the waſte.

EXP. V. This experiment ſhews the degree of fire neceſſary to render the antimony calcined with bone of a white colour; and that this whiteneſs does not depend on the air, but on the fire.

(*a*) 1500 grains of the calcined mixture of antimony and bone, Exp. 3. were kept red hot in a cloſe veſſel for half an hour. On cooling, I found the powder changed from a cineritious or clay colour to a whitiſh colour with a ſhade of yellow. The ſides of the crucible were not glazed. The pyrometer in the middle of the powder had contracted to 40°. This powder was much inferior in whiteneſs to JAMES's Powder, being much yellower.

(*b*) Another parcel of the ſame powder, Exp. 3. was expoſed in the ſame manner, but to a greater degree of fire, in which the crucible was almoſt white hot for half an hour. After cooling, the powder was found changed to a looſely cohering, ſnow-white, heavy maſs, and the ſides of the crucible were covered with a yellow glaze. This maſs, which

was

was easily detached from the vessel, was found covered with a yellow vitreous coat over the whole surface of it that had been in contact with the crucible. In the white solid, on breaking it, many argentine *spicula* were seen. The pyrometer used in all these experiments indicated 71°.

(*c*) 1500 grains of the same parcel, Exp. 3. were exposed in an open crucible to the fire of a melting furnace; no fumes arose till the crucible began to be almost white hot. After inverting another crucible, with a small hole in its bottom, the fumes continued to ascend at times through the aperture for a quarter of an hour. The crucible was then taken out of the fire, and on cooling a *whitish powder* was found, but no glazing, and the pyrometer indicated 28°. On again exposing this crucible with one inverted over it in the melting furnace, but to a greater degree of fire, still more fumes arose; but, on cooling, the charge was still in the state of a powder, though *whiter* than before; and the inside of the inverted crucible was covered with silvery particles, and the hole of it was surrounded with argentine *spicula*, in a stellated form. The pyrometer indicated 39°. On reducing a little of this powder to a greater degree of fineness, it was as white as JAMES's Powder, with a yellowish cast like it, but inferior in whiteness to a specimen of *Pulvis antimonialis*. This crucible, containing its charge, with a cover closely luted on it, was put again into the fire, which was raised much higher than before; and, after being exposed in it twenty minutes, the powder in the crucible became a loosely cohering solid, as *white as snow*, with a vitreous yellow coat, as before observed; the inside of the crucible was glazed and covered with *spicula*. The pyrometer-piece in the middle of the powder was also covered with a yellow coat, but not

glazed, and it indicated 81°. This looſely cohering ſolid being pulverized afforded a *whiter* powder than JAMES's Powder.

(*d*) The crucible, with its charge (*b*), having a cover well luted on it, was again put into the furnace, and the fire raiſed to almoſt as great a degree as I was able. This intenſe heat was kept up above an hour. After cooling, a white hard ſolid maſs was found within the crucible. On breaking the veſſel, to detach from it the charge, this ſolid maſs was found as hard as marble, and to have received its figure from the crucible. Its ſurface was covered with a yellow vitreous coat, and the whole inſide of the veſſel had a beautiful gold-coloured glaze with many argentine *ſpicula*. The pyrometer piece in the middle of the charge was alſo covered with a fine yellow glaze, and indicated 166°. This ſolid, hard maſs weighed only 21 grains leſs than before the experiment, though the whole inſide of the crucible was glazed, and had ſhining *ſpicula* upon it. A piece of this hard maſs being pulverized, it afforded a whiter powder than JAMES's powder is in general.

EXP. VI. 2000 grains of coarſely powdered antimony, mixed with 1105 grains of calcined hart's horn in powder, were calcined firſt in an open veſſel, and then expoſed to a great degree of fire in a cloſe veſſel, as in the above experiments with bone-ſhavings, Exp. 3. and 4. The calcination of this mixture in the open veſſel afforded 2550 * grains, of a leſs whitiſh and rather yellowiſh powder, inſtead of a light aſh-colour, as with bone ſhavings, Exp. 3. p. 353.; and by the ſecond, and even

* In another experiment of this kind 2400 grains of antimony and 1500 grains of calcined bone afforded 3450 grains of yellowiſh light-brown powder. In a third trial, 600 grains of antimony and 400 grains of calcined bone gave 850 grains of yellowiſh brown powder.

repeated

repeated exposure to fire, it never could be made quite so white, but seemed more inclined to melt than the powder prepared with unburnt bone. In other respects the effects of fire were apparently the same, or nearly so, as in the experiments with bone shavings, Exp. 3, 4.; for though the loss of weight in this experiment, reckoning that of the antimony at $29\frac{1}{2}$ *per cent.*, and that of the bone ashes at $2\frac{1}{2}$ *per cent.* should have left 2483 only, instead of 2550; yet, in other similar experiments, the product corresponded nearer to this calculation, and the loss was sometimes less both of the antimony and bone calcined separately. Some of the persons who prepare the *Pulvis antimonialis* say, that the whitest colour is obtained by first boiling the bone shavings to dissolve their mucilage, and then calcining them with antimony as above shewn. Mr. LILE's receipt directs previous decoction of the hart's horn.

It will not be difficult, from these experiments, to give a probable reason for the JAMES's Powder being generally of a yellowish cast, and for different parcels of it, as well as of the *Pulvis antimonialis*, being generally of different degrees of whiteness and shades of yellow. The colour of this preparation is, however, a very delicate one. I once directed a person to calcine together antimony and bone shavings, in the usual manner, to that state in which the white powder may be produced by a due degree of fire; but, instead of a snow-white mass, I could not by any degree of fire obtain any colour but a dirty whitish or light stone colour; though repeated calcinations were employed. The reason of the failure was, that the earthen dish had been broken during the calcination, and a few very small pieces of it had scaled off, and being mixed with the powder occasioned this disappointment

with

with reſpect to colour. The ſame diſappointment has been alſo occaſioned by uſing a ruſty iron rod in calcining the mixture.

The bone-aſhes procured from the ſal ammoniac and ſpirit of hart's horn manufactories, frequently failed in producing a white powder; and ſo did ſometimes the bone-aſhes, called prepared hart's horn, ſold by the druggiſts. Even after a fine white coloured maſs had been made, if it was pulverized in an iron mortar that had extremely little calx upon its ſurface, or dirt, the powder was not white.

The yellow coat and glaze on the ſides of the crucible and ſurface of the calcined mixture of bone and antimony, in theſe experiments, is to be aſcribed rather to the fuſion of the clay of the crucible with the antimonial calx, than to the greater degree of fire in the part of the crucible in which it takes place; or than to the calx of iron and ſiliceous earth of the veſſel: becauſe the ſame yellow coat and glazing are produced on the WEDGWOOD pyrometer pieces, which are placed in the middle of the charge, and where the degree of heat cannot be ſo great as nearer the ſide of the crucible, and yet a ſnow-white maſs is produced between theſe clay pieces and the ſides of the crucible. This effect of clay, in forming a yellow coat and glaze, is ſhewn by the obſervation of what happens when the calcined mixture is put into a WEDGWOOD's crucible, which is made of much purer clay than other veſſels of this kind, and when it is ſet in a larger Heſſian crucible with the ſpace betwixt the two veſſels filled with the ſame calcined mixture. After expoſure to a ſufficient degree of fire, *viz.* about 120° of WEDGWOOD's ſcale, the inſide and outſide of the inner crucible will be covered with a yellow vitreous coat and glaze as well as the inſide of the outer crucible in contact with the charge, while the reſt of the matter within theſe veſſels is of

a ſnowy

a snowy whiteness. This yellow coat is one reason for the powder being of a shade of yellow in some specimens.

Supposing the fusibility of the antimonial calces to be diminished the more they are calcined; the following experiment shews, that the antimonial calx in JAMES's Powder is more calcined than that in Exp. 2.

EXP. VII. $70\frac{1}{2}$ grains of calcined antimony, as prepared in Exp. 2. triturated with $53\frac{1}{2}$ grains of calcined bone, formed a powder of a bluish cast, which being exposed in a close crucible, for half an hour, in a melting furnace, the degree of fire in which was 120° of WEDGWOOD's scale, it was found melted into a vitreous, pale bluish mass; and the inside of the crucible was glazed yellow, with red streaks, and had argentine *spicula* adhering to it.

EXP. VIII. 800 grains of the calcined antimony of Exp. 2. were calcined for eight hours in a dish, as in making LILE's Powder, by stirring it constantly, and keeping the bottom of the vessel red hot during the whole time; the two last hours also the whole of the powder was kept red hot. On cooling, this calx was an impalpable light-brown powder.

(*a*) 100 grains of this calx, triturated with an equal quantity of calcined hart's horn, formed a powder very unlike JAMES's Powder, for it was of a light-brown colour. On exposing it to about 120° of fire it melted into a yellow opaque mass.

(*b*) The remaining 700 grains of the calcined antimony of this experiment were exposed to fire and air as before for eight hours longer, and kept red hot a great part of the time; but the calx became very little lighter coloured than before.

(*c*) 100 grains of this calx last mentioned (*b*), triturated with as much calcined hart's horn, being exposed to the degree of fire usually applied in making the *Pulvis Antimonialis*, in a

cloſe veſſel, the mixture melted partially into a greyiſh maſs.

(*d*) 150 grains of the calcined antimony (*b*) of this experiment were mixed with an equal weight of calcined hart's horn. This mixture was raked about in an earthen diſh for an hour, during a great part of which time it was red hot. On cooling, the powder was evidently lighter coloured than before this calcination. It was then expoſed in a cloſe crucible to a white heat for half an hour; and, after cooling, a looſely cohering white ſolid, with a vitreous yellow coat, was found, little inferior in whiteneſs, and otherwiſe reſembling JAMES's Powder.

(*e*) 300 grains of the calcined antimony (*b*) of this experiment were raked about in an earthen diſh for an hour, a great part of which time they were kept red hot. On cooling, the calx was found of the ſame colour as before; and after expoſing it in a cloſe crucible in the melting furnace to almoſt a white heat for half an hour, it was obſerved to have been melted into a yellowiſh maſs.

It ſeems at leaſt very probable, from this experiment, that no degree or duration of fire, applied in open or cloſe veſſels to antimony *alone*, can produce a calx of the ſame kind as that in JAMES's Powder: nor, perhaps, can ſuch a powder be compoſed by fire applied, in cloſe veſſels, to calx of antimony mixed with calcined bone; but if antimony duly calcined be mixed with calcined bone, and expoſed to air, in a due degree of fire, for a ſufficient length of time, and then a ſtill greater degree of fire be applied to it in cloſe veſſels, ſuch a compound may be formed as JAMES's Powder. This experiment alſo proves, that the ſulphur in antimony is no ways neceſſary to the formation of this compound.

 The

The manner in which air and fire act upon the antimonial calx and phofphorated lime, I fhall venture to conjecture.

It is probable, that the calx of antimony and phofphorated lime combine with each other. 1. Becaufe it requires the application of heat and air for a fhorter fpace of time to feparate the fulphur from a given quantity of antimony mixed with bone-afhes than to produce this effect on antimony *by itfelf:* nor can the fpeedy calcination of antimony with bone-afhes be explained by fuppofing that the antimony can then bear more heat without melting; for the difference in the degree of heat applied in the two cafes is not, apparently, fufficient to account for the difference of the times required for defulphurating the antimony. 2. Becaufe it appears, that heat, applied to antimony in a confiderable variety of degrees, and air for various fpaces of time, formed a calx very different in colour, fufibility, and other chemical qualities, from that produced by calcining this metallic fubftance with bone-afhes. The ftrongeft confirmation, perhaps, of the opinion that the antimonial calx and phofphorated lime are chemically united together is, that, however long the calcination of the antimony and bone-afhes is continued in the open veffel it will only produce precifely the fame fubftance, with refpect to chemical properties, that is produced the moment the fulphureous fumes ceafe.

But why is a fnow-white powder produced by expofing a mixture of calcined antimony and bone-afhes to air and fire for a due length of time, and then applying a greater degree of fire in clofe veffels, whereas no fuch white powder is formed by a mixture of any calx of antimony and bone-afhes, expofed to any degree of fire in clofe veffels, without previous expofure to fire and air? The reafon may be, that in order that the calx fhould unite with the phofphorated lime, it muft be calcined to one

 certain

certain degree; which is effected by expoſure to air and fire with the bone-aſhes when it can part or combine with air, ſo as to be reduced to that ſtate in which it will be duly calcined for union with that ſubſtance, which could not happen in cloſe veſſels.

If it be objected, that this explanation does not account for the *whiteneſs* of this preparation, which is only produced by a white heat, and to which air is not neceſſary, the difficulty will be removed by conſidering that this whiteneſs may be induced without any chemical alteration effected by the fire: for, after the firſt calcination in the open veſſel, it ſeems to act, principally, in the ſame way that it does in making grey coloured bone-aſhes, or imperfectly burnt bone, of a ſnowy whiteneſs, namely, by totally deſtroying matter extraneous to the phoſphoric ſelenite. Fire alſo, in many inſtances, alters the colour of bodies without occaſioning any change in their compoſition; and, perhaps, the change of the light clay or cineritious powder, formed by the calcination of antimony and bone-aſhes in open veſſels, to a ſnowy-white ſubſtance by further expoſure to fire, depends in part upon its increaſe of ſpecific gravity or other mechanical effects of fire. A ſtriking example of the power of fire to change the colour of bodies, by merely increaſing their ſpecific gravity, is afforded by the operation of quartation, in which proceſs, the ſilver being parted, the gold is left of the colour of copper; but, by expoſure to a due degree of fire, it is changed to its well known yellow colour, without undergoing any alteration except an increaſe of ſpecific gravity.

To elucidate the nature of the inſoluble and infuſible part of JAMES's Powder, I made the following experiments, in which I particularly had in view to determine whether ſeveral antimonial calces be wholly ſoluble in acids.

EXP.

EXP. IX. (*a*) Needle-like cryſtals of Algaroth powder diſſolved readily and totally in about thirty times their weight of marine acid.

(*b*) Part of the ſame parcel of cryſtallized Algaroth powder was calcined for above two hours, during which time it was expoſed to as great a heat as it would bear without melting, and during which time it was conſtantly raked about. Nearly half of this calcined calx readily diſſolved in marine acid, and by boiling the remainder in a proportionally much greater quantity of the ſame acid, great part of it was diſſolved, and the ſmall part which ſtill reſiſted ſolution could not be diſſolved in above 100 times its quantity of hot *aqua regia*. This indiſſoluble part afforded regulus with tartar by means of heat applied with the blow-pipe.

(*c*) White flowers of antimony generally left a reſiduum that was either inſoluble, or diſſolved with great difficulty, and in a ſmall proportion, in marine acid or *aqua regia*; yet this reſiduum was reducible. Some parcels of this calx *totally* diſſolved.

(*d*) A little of the antimony, long calcined in a former experiment, and afterwards melted into a yellow maſs, Exp. 8. (*a*), would only partially diſſolve in marine acid and *aqua regia*; but the copious reſiduum it left was reduced.

(*e*) Equal weights of cryſtals of Algaroth powder and calcined bone mixed together, diſſolved *totally* and readily in marine acid. This ſhews, that diſengaged phoſphoric acid does not precipitate antimonial calx when marine acid is preſent.

(*f*) The *calx antimonii nitrata* of the Edinburgh Diſpenſatory, argentine flowers of antimony, hyacinthine glaſs of antimony, and calx precipitated from antimonial tartar by alkali of tartar, all diſſolved readily and *wholly* in marine acid; but,

(*g*) Diaphoretic antimony left a reſiduum which mixed with tartar formed metallic grains under the flame applied by means of the blow-pipe.

(*h*) Any of the above ſoluble antimonial calces by further calcination with air and fire become more difficultly ſoluble, or partly indiſſoluble.

The next experiments were made principally for the purpoſe of knowing whether antimony calcined with vitriolic ſelenite, calcareous earth, and ſiliceous earth, would afford the ſame ſort of calx as antimony calcined with bone-aſhes.

EXP. X. 1500 grains of well burnt and dry plaſter of Paris, mixed with as much pulverized antimony, were calcined together in the ſame manner as the mixture for making LILE's Powder, Exp. 3. In half an hour the ſulphureous fumes diſappeared; after calcining half an hour longer in a heat that kept the bottom of the diſh red hot, the mixture was of a reddiſh brown or copper colour, and after cooling weighed 2520 grains. Suppoſing, therefore, the whole deficiency of weight in this experiment to be from the ſulphur carried off; and ſuppoſing the quantity of air combined with the metal to be the ſame as in Exp. 2. the loſs of weight *viz.* 32 *per cent.* is more than would have been expected; but as in experiments of this nature it is not perhaps poſſible to repeat them under preciſely the ſame circumſtances, the difference of 2½ *per cent.* deficiency more than would have been calculated, may more reaſonably be aſcribed to the ſublimation of antimony than to other cauſes. By expoſure to 70° of fire in a cloſe crucible, this calcined mixture changed to a pale ſtraw-coloured powder, and the ſides of the veſſel were glazed yellow. The change of colour was the ſame in an open veſſel in 60° of fire.

Though

Though it is probable, from this experiment, that there is an affinity between antimonial calx and vitriolic ſelenite, it is plain that the compound is very different from JAMES's Powder.

The next experiment with chalk and antimony, which Dr. BLAGDEN had the goodneſs to ſuggeſt, would lead to ſeveral concluſions, but I ſhall only take notice of the compoſition produced.

EXP. XI. 1200 grains of antimony were mixed with 800 grains of well waſhed, dried, and pulverized chalk, and calcined as in making LILE's Powder. In leſs than an hour the ſmell of ſulphur diſappeared; after which the mixture was calcined half an hour longer. It afforded a lighter clay-coloured powder than the calcination of antimony with bone-aſhes; and weighed 1800 grains. By expoſure to 100° of fire this powder changed to a dirty white colour. On examination, inſtead of aërated lime or chalk, there was found vitriolic ſelenite, part of which was probably combined with the antimonial calx; for, by means of boiling water repeatedly applied till the lixivium did not become turbid with muriated barytes nor acid of ſugar, I could only obtain 12 *per cent.* of vitriolic ſelenite, mixed with a little antimonial calx; but by means of nitrous acid I ſeparated 45 *per cent.* of this ſelenite, with ſcarcely any antimonial calx in it. The reſiduum, after this ſolution in nitrous acid, was calx of antimony with a little vitriolic ſelenite ſeemingly vitrified. Accordingly the compoſition may be ſtated to conſiſt of 1000 parts of antimonial calx and 950 parts of vitriolic ſelenite which I infer from the quantity of ſelenite diſſolved by the nitrous acid, and eſtimated to remain united to the calx; and from the following calculation of the proportion of theſe two ingredients formed in the experiment.

Antimony.		Sulphur.		Air.			
1200	−	300	+	100	=	1000	Antimonial calx.
Calcar. earth.		Aerial acid.		Vitriolic acid.			
800	−	300	+	450	=	950	Vitriolic ſelenite.
						1950	
Loſs by ſublimation and waſte						150	
						1800	

With regard to the nature of this calx, the greateſt part of it readily diſſolved in marine acid; and part of what then remained was alſo diſſolved, but with great difficulty and very ſparingly; a minute quantity reſiſted ſolution entirely.

EXP. XII. 600 grains of coarſely powdered antimony were mixed with 400 grains of purified white ſand, and calcined as in making LILE's Powder. The ſmell of ſulphur continued for one hour and a half, and the mixture was calcined for half an hour longer. On cooling, a brown powder was obtained which weighed 820 grains, and expoſed to 100° of fire, melted into an irregularly figured, blackiſh maſs, full of cavities.

In this experiment the loſs of weight correſponds nearly to that in experiments above related, *viz.* thoſe in which the deficiency of weight after calcining antimony alone was about 29½ *per cent.* The much longer time required in this experiment for carrying off the ſulphur than in the calcinations with bone-aſhes, gypſum, and chalk, perhaps is owing to there being no affinity between antimonial calx and ſiliceous earth.

I beg leave to mention one more experiment relative to JAMES's Powder.

EXP. XIII. A medicine is ſold by F. NEWBERY, under the title of "JAMES's Powder for Horſes, Horned Cattle, Hounds, &c." It is a light clay-coloured, gritty, taſteleſs ſubſtance, in which

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are ſeen ſmall *ſpicula*. It appears to me to be nothing more than JAMES's Powder for Fevers, or LILE's Powder above-mentioned, made by calcining antimony and bone-aſhes together in open veſſels; becauſe, 1ſt, by expoſure to a white heat in cloſe veſſels, it turns as white as JAMES's Powder. 2dly, It diſſolves partially in nitrous acid; and the remainder diſſolves partially in marine acid. The nitrous ſolution contains phoſphoric acid and calcareous earth; and the muriatic ſolution affords Algaroth powder.

From the whole of the above *analytical experiments* it appears:

1. That JAMES's Powder conſiſts of phoſphoric acid, lime, and antimonial calx; with a minute quantity of calx of iron, which is conſidered to be an accidental ſubſtance.

2. That either, theſe three eſſential ingredients are united with each other, forming a triple compound, or, phoſphorated lime is combined with the antimonial calx, compoſing a double compound in the proportion of about 57 parts of calx and 43 parts of phoſphorated lime.

3. That this antimonial calx is different from any other known calx of antimony in ſeveral of its chemical qualities. About three-fourths of it are ſoluble in marine acid, and afford Algaroth powder; and the remainder is not ſoluble in this menſtruum, and is apparently vitrified.

From the preceding *ſynthetic experiments* it appears, that by calcining together bone-aſhes, that is, phoſphorated lime, and antimony in a certain proportion, and afterwards expoſing the mixture to a white heat, a compound was formed conſiſting of antimonial calx and phoſphorated lime, in the ſame proportion, and poſſeſſing the ſame kind of chemical properties, as JAMES's Powder.